AN OPTIMAL RESOURCE SCHEDULING AND DYNAMIC PRICING AUCTION MECHANISM FOR SUPPORTING EMERGENCY DEMANDS IN CLOUD COMPUTING

A SYNOPSIS

Submitted by

R. ANANTHAKUMAR

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ANAND NAGAR, KRISHNANKOIL – 626 126

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1. INTRODUCTION

Programs and information are continuously stored into computer's magnetic disc for access or retrieve for future need. This process is generally called as computing. However, current technology has replaced this system as there has been no need to store everything on the physical magnetic disc used by Rana et al. [1]. As a result, the scenario has changed to the creation of what is called as cloud computing (CC). In its essence, cloud computing is the latest technique in which the information and programs are hold on over the internet and not on local magnetic disc. This internet is known as cloud in 'cloud computing'. In organizations too, information and programs are kept over the internet which involves an organization's requirements, where the necessities are even a lot. Making a physical infrastructure for servers, applications, storage, and so on would end up with time consuming and additional cost. This can be overcome, when a share of what is already put in over the web to be used is engaged. Thus, there will be cost efficiency and facilitation in meeting the requirements furthermore. Hence, cloud computing architecture is highly supported and utilized for sharing the computing resources.

Delforge and Whitney [2], described Cloud computing took long number of years in its evolution and that too in various phases. Chronologically, the world network emerged during the decade of 1960. The concept of cloud computing was arrived for the purpose of interconnecting everyone and to use information and programs from any web site placed anywhere globally. Though the construct was already provided, the usage of internet usage got its importance with the launch of a smart bandwidth during the 1990's. Another key factor that enhanced the evolution of cloud computing was the emergence of the virtualization of technology.

Metering based on usage is available through which the user has to pay only for the service used. Though various service models exist in cloud computing, the advancement of technology has paved way for newer service models.

Prerita et al. [3], covered three major service models are significant for cloud computing namely

- Infrastructure as a Service (IaaS),
- Platform as a Service (PaaS), and
- Software as a Service (SaaS).

IaaS – In this model, users are able to access the infrastructure needed to perform their applications, effect the storage, platform, from the given cloud. Normally infrastructure refers to servers, storage and virtualization. Purchasing the infrastructure for the needed configuration is terribly costly and complex for the organizations. Also, a lot of expenses have to be made for maintaining these services.

PaaS – Platform as a Service, is a platform for developing, running and managing the applications sought by the end users. There is no need to worry about technology updates and maintenance. All the latest technology updates, maintenance are taken care by the service providers.

SaaS – Software as a Service enables the users to access cloud applications. This does not involve any costly software for individual systems. Here, application can be accessed through the software package from a thin consumer interface, sort of an application program.

Apart from the services mentioned above, there are newer service models such as XaaS (Anything as a Service), CaaS (Communication as a Service), and MaaS (Monitoring as a Service). Users are at their liberty to select the desired model or models, which may lead to support business necessities and prices depending on their need. The cloud services are often employed in several applications. The cloud relies on the service model, structure of the servers, location and user base, and so on.

As mentioned by Doelitzscher et al. [4], The following are the four most typically used deployment models:

Public Cloud: In this model, the cloud infrastructure which is owned by a provider offering the cloud services is available for access to the public users. The cloud provider shares cloud resources with users. Since resource pool is large, equally large volume of users shares the services.

Private Cloud: Private cloud is private to an organization or a group. Here, the cloud is owned by the user or an organization with exclusive access, thereby creating secured information and transactions. Comparatively, there is an additional management over resources than in the public cloud model.

Community Cloud: Under the community cloud, the cloud infrastructure is owned by different organizations having an identical set of requirements, policies, and client base. Hence, the organizations combine the offerings and build the client base even larger than the normal one.

Hybrid Cloud: This model contains two or more clouds and can be a combination of

other three cloud models viz. public, private, or community. Yet, the hybrid cloud is complicated compared to other models in terms of execution and management tasks. A sample situation of this model is that wherever a corporation is on the personal cloud there may be load spikes that the private cloud cannot handle.

2. LITERATURE REVIEW

As per Buyya et al. [5], there is a progressively perceived vision that computing can at some point become the fifth utility (after water, electricity, gas, and telephony). The utility of computer, along with any other essential utilities, is sure to facilitate day-to-day activities globally. Researches are focused on deriving core paradigms to attain this mission of which cloud computing has been a significant platform. The authors of this literature attempted an outline of cloud computing and came out with a design for modelling the clouds. For this they have included the need of market-resources by placing the leverage on ongoing technologies like virtual machines. Further stress is on the provision of market-oriented resource management models to satisfy the individual customer need.

Beloglazov and Buyya [6], examined resources utilization and efficient energy with regard to cloud data centers. They also proposed virtual machines of dynamic consolidation manner to be deemed as efficient. Deciding the ideal reallocation of virtual machines from an over-loaded host is a crucial consolidation process in virtual machine applications. Such a decision shall achieve a direct impact upon the use of resources and Quality of Service (QoS) delivered by the data center. To improve the consolidation of virtual machines, care must be taken to enhance the time intervals for migrating the virtual machines from respective over- loaded hosts. Generally, the consolidation of virtual machine is linked with reduction of quantity in dynamic physical hosts.

Priyanka and Sankari [7], used Particle Swarm Optimization (PSO) for server consolidation. Server consolidation is a powerful system to expand the usage of resources while diminishing power utilization in a distributed computing environment. To apply this strategy, live virtual machine migration is utilized. It joins virtual machines existing on different underutilized servers onto a single server, with the goal that the remainder of servers can be put to a sleep mode. Utilization of the physical

machines is set to a maximum of 70%. It does only a local search for utilization. But a globalized search with more utilization can improve the results further.

Wu et al. [8], targeted on allocating the resource for SaaS suppliers with a specific aim of price reduction. In addition, it increases client satisfaction level by minimizing the quantity of service level agreement violations. To realize this goal, the work was done with respect to client profiles and key performance indicator criteria, along with mapping of exploitation and mechanisms related to planning. By this, the dynamic demands and resource level uniformity are handled. The work conjointly enforced two client-oriented algorithms by considering varied QoS parameters (such as rate of arrival, time span for service initiation, and rate of penalty) from each customer and views from SaaS suppliers.

Also, most applications nowadays are moved to the cloud and most of the customers depend on the cloud even though they own a good computing capacity. All the servers are taken up by the cloud data centres, and the client resources are considered merely, while providing the service. Projects like Folding home and Trichome by Anderson et al. [9], Beberg et al. [10], are some of the key initiators in using resource provided by users. These projects handle the user's idle resources for data processing of disease research and radio telescope data from space. These resources are intended to work for the application alone. But the same technology can be used for computational challenges in the cloud.

At the user's side, most of the recent software and operating systems support the latest hardware. So, the users are also moving to get the latest hardware. But what happens to the outdated systems is a challenging question before green computing. As mentioned by Tam [11], the normal life span of a PC in the '90s was about 5 years. Yet this worth was abatement to just 3 to 2 years now. Since open fire burns at moderately low temperatures, it discharges a larger number of poisonous gas than in a controlled cremation process at a burning plant. Inhalation of open fire gases can trigger asthma, respiratory diseases, and cause different issues, such as, wheezing, chest pain, and eye irritation. Some materials are dumped into landfills by which hazardous materials blend with soil and contaminate the soil and water.

Fosdick [12], reported that a 10-year-old computer can do anything similar to the new computers if it is properly configured. All Pentium IV and above computers are packed with minimum 1.3 GHz of processor, and 256 MB to 4 GB of RAM for Pentium IV and 1 GB and above RAM for dual-core processors.

Prasad et al. [13], examined the researcher assessed the complexity in cloud precondition arrangements, application responsibilities as well as allocations of resource. The CloudSim reproduction innovation assists to conduct and structure demonstrating in the cloud datacentres used by Prasad and Rao [14]. Simao and Veiga [15], described the various kinds of techniques for resource allocation in the exits relocation execution. Bonacquisto et al. [16], mentioned the researcher built up a Honeybee Behaviour Inspired Load Balancing (HBB-LB) for achieving better load balancing and throughput enhancement in the cloud computing systems.

3. OBJECTIVE

The main objectives of the research are as follows:

1. To reduce unused computing capacity using demand-based preferential resource allocation technique to increase resource utilization.
2. To increase the user satisfaction in cloud resource allocation using Mergeable Auction [MA] mechanism.
3. To improve the performance of cloud resource allocation using Dynamic Pricing with Combinatorial Auction Mechanism (DPCAM).

4. RESEARCH PROBLEM

Resources in cloud are limited. Hence it is always a challenge for the cloud providers to provide all the demanded services on time and in an efficient manner to the subscribers within an accepted SLA. From Cloud provider perspective it is to maximize the profit of service providers and to satisfy the consumer to minimize the time and cost.

Below are the problems identified with Fixed-Auction-Resource allocation Mechanism,

- Minimal user satisfaction.
- Increased capital cost for user.
- Delay in providing the resources to the user.

5. CONTRIBUTIONS

5.1 An Inclination based Progressive Resource Allotment Strategy in Cloud Computing Systems

To reduce unused computing capacity using demand-based preferential resource allocation technique to increase resource utilization. A market-driven auction mechanism to identify users for resource allocation based on their payment capacities and implements a payment strategy based on a buyer's service preferences. A comparison is drawn between the proposed allocation technique and the Fixed price mechanism and results show a performance benefit in revenues to service provider, payments of cloud users besides ensuring optimum resources use.

As the cloud contains many resources, there may also wastage of resources. To reduce this wastage, cloud providers enter auctioning of resources when the demand is high. Cloud computing includes distinct resources.

The proposed resource allocation system mode, there are N users, denoted as $n_1, n_2, n_3 \dots \dots and\ n_N$. A single cloud provider manages three types of VMs as $k_1, k_2\ and\ k_3$ Service provider maintains updated information about the availability and demands of these VMs. It helps the provider in determining the starting price (SP_{VMtype}) of each VM type at the start of auction. The Resource Allocation Unit (RAU) is divided into two sub-units as Auction Sub-unit and Payment Sub-unit. The purpose of auction sub-unit is to determine winners among bidders and payment sub-unit charges winners according to their preferences and bid prices.

Pre-Auction:

An i^{th} round of the resource allocation technique starts at time t=0 when a cloud service provider establishes the starting price of each type of VM instance

$$(SP_{VMtype})_i = (MeanBP_{VMtype})_{i-1}$$

a cloud service provider also calculates the additional cost:

$$AC = DSC + DTC + TPC + IC_{VMtype}$$

Market-driven Open Auction:

The 2nd step of resource allocation technique is an auction process which is divided into two halves. At t=0, the service provider declares the starting prices of to the public and invites bid-prices from interested users for each required VM type,

$$BP_{VMtype} > SP_{VMtype}$$

Interested users or bidders submit their task's VM requirements along with their best bid for each VM type as per the format given

User ID	AT	RK1	BPK1	RK2	BPk2	RK3	BPK3	TBP

Preference-driven Payment:

Actual payment made by a winner i is compared against his bid-price payment (BPP) which is calculated using equation

$$BPP_i=[(RK1*BPK1)_i + (RK2*BPK2)_i + (RK3*BPK3)_i]$$

Simulation Setup:

simulation environment runs on a PC with the following configurations: 2 CPU cores, 4 GB RAM, and Microsoft Windows 7. an experimental setup regarding cloud environment through a simulation toolkit called Cloudsim. This toolkit facilitates modelling for simulating cloud computing systems and provides applications in environment provisioning.

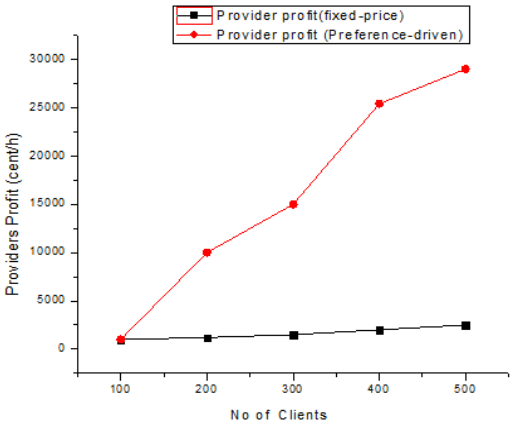


Figure 2. Provider Profit for Fixed price mechanism Vs Preference-driven

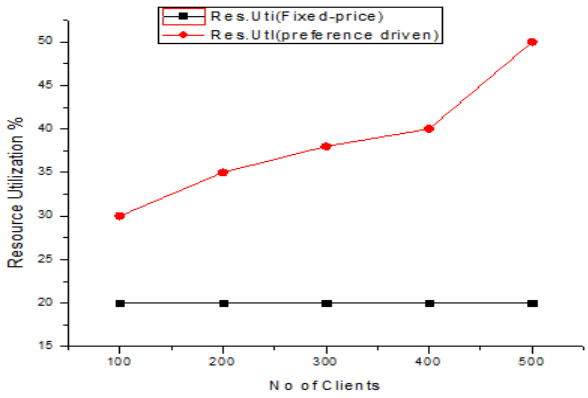


Figure 3. Resource utilization for Fixed price mechanism Vs Preference-driven

The planned resource assignment method remains investigated CloudSim context comprising 3 various resources among various cases, a solitary offer/resource supplier also numerous client. In a solitary portion cycle, four victors were distinguished in addition to their maximum along with minimum genuine instalments as appeared in Figure 2. Figure 3 demonstrates the variety about incomes received via the utility supplier not as much as his offer cost. This instalment system jobs for cloud clients gave such they reference their greatest offer cost towards triumph sale.

A demand-driven preferential resource allocation technique is introduced involving a truthful auction process followed by a fair payment mechanism. This

proposed technique involves bid revisions, re-biddings and multiple payment criteria for a cloud user whereas a service provider draws maximum advantage by following the current demands of resources and setting their prices accordingly. A comparative study between the proposed technique and the well-researched Fixed price mechanism is also presented which highlights the performance benefits of the present work.

5.2 Effectual Resource Allocation using Auction Mechanism in Cloud Computing

Cloud computing is one of the fastest emerging technologies. As we all know, cloud is a wide pool of resource which provides resources based on the user's request. Any service can be provided as a service through cloud. As the cloud contains many resources, there may also wastage of resources. To reduce this wastage, cloud providers enter auctioning of resources when the demand is high. Cloud computing includes distinct resources. Because of the complementary and supplementary effects between distinct assets, bidders have preferences not for just a single resource but also for a set of resources. Auctioning for a bundle of resources is called mergeable auction (MA). Dynamic resource allocation in on demand for a bundle of resource is proposed by using MA – PROVISION algorithm and the scenarios are simulated using Cloudsim, a simulator meant for cloud computing analysis.

- Dynamic resource allocation provides economic benefit to the provider and the client has to pay only for the usage of the resources. Truthfulness can be attained.
- Any combination of VM's can be obtained from the available resources.
- Instead of single resource, auction for the bundle of resources or combinations is called mergeable auctions.

This algorithm is divided into three major phases is shown in Figure 4. Collecting the bids from the users, winner determination by density calculation and payment. A cloud provider might consist of n different types of VM instances and its weight based on computing power is indicated by w. Cloud providers decides the weights for the resources during the configuration of the resources itself. Users can able to choose any type of VM instances they want and bid for the resource in combinations as

$$b_j = \left(r_1^j \ldots\ldots r_{m,}^j V_j\right)$$

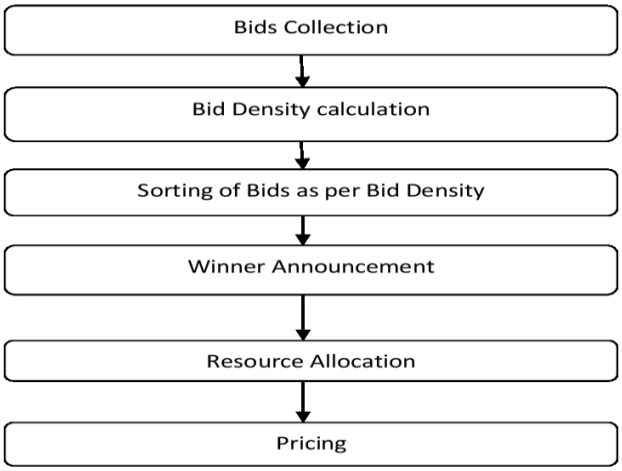


Figure 4. Flow chart in support of MA – PROVISION method.

This indicates the user j is requesting the bid containing the m different types of resources they are in need. In this bid request, V_j is the amount the user wishes to pay for the requested resource. Winner determination is done based on the calculation of densities of bids. Density of the bid is calculated by using the formula,

$$d_j = V_j / s_j$$

where, V_j represents the amount, the user wishes to pay for the resource and s_j is given by the number of instances of resources allocated and the weights of the resources. The bid density is how much amount the user wishes to pay for single unit of resource in need. The densities of the users are sorted in descending order. Users with the highest bid are assigned the winner and the winners are sorted in the list based on their densities. Provisioning of resources is done on the basis of this sorted order in the all or none basis. After allocation of resources for a user the environment is checked for any deadlock condition. If it is found then the rollback operation is implemented.

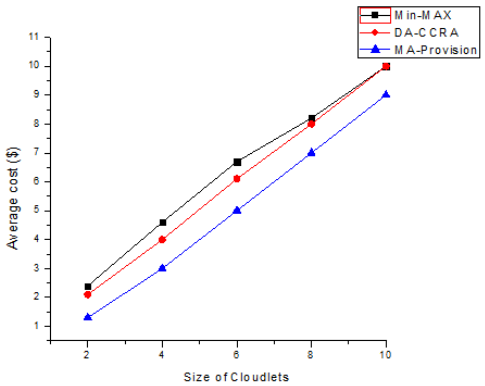


Figure 5. Average cost of cloudlets

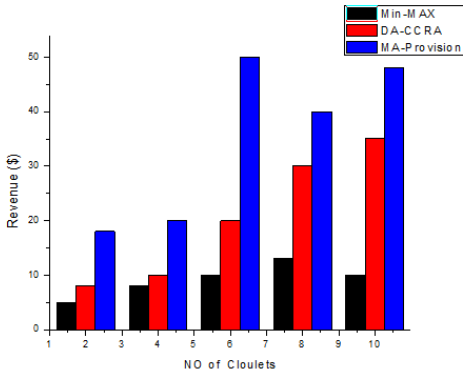


Figure 6. Revenue of cloudlets

Figure 5 and Figure 6 we make a comparison with two auction model, in the three-model increasing the number of cloudlets, our proposed MA mechanism is cheaper than other model and fast execution time.

This work proposes a new cloud computing resource allocation model based on a Mergeable auction mechanism. The main advantages of the proposed model are summarized as follows: it can satisfy both user and provider requirements, it can reduce the average time for resource allocation and pricing, and it can generate higher revenues. Future research will extend the MA – PROVISION model to intuitionistic fuzzy environment.

5.3 An Optimal Resource Scheduling and Dynamic Pricing Auction Mechanism for Supporting Emergency Demands in Cloud Computing.

Cloud resources provide various categories of (VM) virtual machine requests which is assigned with clients for an exact timespan. Currently, the method of VM scheduling within the Cloud environment is decided by a fixed-price scheduling algorithm, during which the user pays a fixed amount per unit time so as to obtain the resources. However, such a scheduling algorithm is not effective for Cloud even though the Cloud resources are dynamically allocated and released. To address this issue, the adaptive scheduling algorithm called as Dynamic pricing based Combinatorial Auction allocation mechanism is proposed. It will be used to increase the resource utilization as well as user satisfaction through dynamic pricing with the combinatorial auction.

Our Proposed market-based scheduling algorithm uses the principle of auction mechanism for the purpose of extends the satisfaction of Cloud suppliers and clients. This technique reconstructs the current preferences of resource allotment so as to allot resources in advance for emergent virtual machine demands. Then Collective-target augmentation numerical prototype is demonstrated, which forms the minimal execution equivalent range connecting physical machines with virtual machines, and the objectives of resource allotment is to obtain minimal quantity of physical machines. The simulation experimental outcomes express that the proposed scheduling methodology and Collective-target augmentation numerical prototypes are capable to adequately increase the quality of service (QoS), improves profit of suppliers and resource utilization.

Allocation of resources based on Dynamic Pricing Auction Mechanism (ARDPAM):

The allocated tasks initiate a sale as indicated by the particular request to choose the minimal result of the termination time with total capital cost resources. Furthermore, suppliers provide individual offers $bid_j = (SP_{j,}CC_j)$ which show starting price and computation capability of resource$_j$. While shifting implementation against the first cloud supplier to the second, getting extra price is not allowed. One resource assigned task will be implemented up to its termination on the particular resource and reallotment cannot be allowed to a preferable resource or less expensive throughout its implementation. Table 1 displays the allotment of resources based on DPAM. It shows, the establishment time obtains the bigger one between free time of resource and prior task termination time. The implementation time will be measured when the workload is divided through the computation capability while, termination time obtains the total about the establishment time, with implementation time.

The evaluation of TC obtains the result of capital cost with termination time. Tasks choose the resource including the smallest TC. In this method, the resource cost can be progressively altered to develop supplier's competitiveness. first supplier triumphs a sale, price of the resource will be placed as fixed. Or else, the price of the resource will be reduced at an acceptable payment in the succeeding sale. Although, in any sale, the price of the resource cannot be smaller than capital cost. In Table 1 shows the allocation of resources based on the DPAM. 20% is determined as the price reduction rate.

In Initial auction, task A initiates a sale with three resources, and they provide individual auctioneer given their bids (CC, CP), which is displayed in Table 1(a), and the price of resource in current auction is denoted in the current price. Due to minimum TC of resource 2, task A chooses it as the champion. Other resources 1 and 3 give up the sale. Moreover, they reduce the costs with 20% as shown at Table1(b). Champion of 2nd auction is resource 3 which is chosen by task B while the current price of resource 1, 2 is reduced by 20% as displayed in Table 1(c). Likewise, resource 1 is the winner chosen by task C and resource 3 is the winner chosen by task D. The termination time about the system is 2.12 and it is the termination time of the final task displayed in

Table 1. The total capital cost of entire tasks is 8.98+13.50+23.13+41.09=$86.7. The result of total capital cost with termination time is $498.01.

Table1. Resource allotment process of DPAM

RID	CP($)	ET(sec)	IT(sec)	TT (sec)	CC($)	TC($)	WR
			a) Initial Auction				
1	0.12	0.00	2.18	2.18	10.57	54.96	
2	**0.18**	**0.00**	**4.11**	**4.11**	**8.98**	**28.55**	2
3	0.15	0.00	5.20	5.20	9.25	38.01	
			b) First Auction				
1	0.09	3.18	3.00	6.18	21.15	130.70	
2	0.18	3.18	1.86	5.04	18.90	95.25	3
3	**0.12**	**3.18**	**2.22**	**5.40**	**13.50**	**72.90**	
			c) Second Auction				
1	**0.07**	**3.18**	**2.55**	**5.73**	**23.13**	**132.53**	
2	0.12	3.18	3.38	6.56	42.30	277.48	1
3	0.14	3.18	1.28	4.46	37.01	165.06	
			d) Third Auction				
1	0.07	7.18	6.78	13.96	43.09	601.53	
2	0.12	7.18	5.55	12.73	46.92	597.29	3
3	**0.10**	**7.18**	**4.94**	**12.12**	**41.09**	**498.01**	

RID-resource identifier, CP-Current Price, ET-Establishment Time, IT-Implementation Time, TT-Termination Time, CC-Capital Cost, TC-Time*Cost, WR-Winner

Allocation of resources based on Dynamic Price Combinatorial Auction Mechanism (ARDPCAM)

Our mechanism presents the reduction rate for bundle of resource allocation, Cloud provider, and it focus on pricing innovation with the objective of helping the end users to save more. This gives more cloud storage for fewer prices, while maintaining simplicity and adaptability. The resource cost is fixed from the actual Microsoft Azure price list (https://azure.microsoft.com/). Cloud Users will get a discount on Azure services by buying reservations. They offer one-year or three-year resource reservation to users and they provide discounts up to 72 percent.

Allocation of resources based on DPCAM is displayed at Table2. Then reduction rate of price can be fixed as 30%, 41%, 44% and 45% respectively. Initially, an auction is started by task A and offers (CC, CP) given by three resources. Reduction Rate for Bundle of Resources is the reservation of resources up to one year is displayed in Table 2(a).

In DPAM, due to minimum TC of resource 2 it is chosen as the champion by Task A. Other resources 1 and 3 give up the sale moreover, they reduce the current

prices by 30% in one year resource booking scheme dependent on ARDPCAM and chooses resource 3 as a champion in Table 2(a).

At 2nd auction, resource3 is the champion chosen by task B. Then other resources 1, 2 and resource 2 reduce their Reduction Rate for Bundle of Resources by 41% as shown in Table 2(b) and it declares resource 2 as a winner. Likewise, resource 1 is the winner chosen by task A. Then resource 2, 3 decreases their Reduction Rate for Bundle of Resources by 44% as shown in Table 2(c) and it declares resource 3 as a winner. Task D chooses resource 2 as a champion, suddenly resource 1, 3 decreases their Reduction Rate for Bundle of Resources by 45% as shown in Table 2(d) and it declares resource 2 as a winner. The termination time about the system is 12.73 that is final task's termination time. Then the entire task's total capital cost is 7.41+11.16+16.28+24.89= 59.74. The result of total capital cost and termination time is 316.84 as displayed in Table 2.

Table 2. Resource allocation process of DPCAM

RID	CP ($)	ET (sec)	IT (sec)	TT (sec)	CC	TC ($)	RRBR	CATC ($)	WR
				a) Initial Auction					
1	**0.12**	**0.00**	**2.18**	**2.18**	**10.57**	**54.96**	**7.41(30%)**	**16.15**	
2	0.18	0.00	4.11	4.11	8.98	28.55	-	28.55	1
3	0.15	0.00	5.20	5.20	9.25	38.01	6.48(30%)	33.69	
				b) First Auction					
1	0.09	3.18	3.00	6.18	21.15	130.70	12.48(41%)	37.44	
2	**0.18**	**3.18**	**1.86**	**5.04**	**18.90**	**95.25**	**11.16(41%)**	**20.75**	2
3	0.12	3.18	2.22	5.40	13.50	72.90	-	72.90	
				c)Second Auction					
1	0.07	3.18	2.55	5.73	23.13	132.53	-	132.53	
2	0.12	3.18	3.38	6.56	42.30	277.48	34.56(44%)	226.71	3
3	**0.14**	**3.18**	**1.28**	**4.46**	**37.01**	**276.09**	**16.28(44%)**	**72.60**	
				d) Third Auction					
1	0.07	7.18	6.78	13.96	43.09	601.53	23.71(45%)	330.99	
2	**0.12**	**7.18**	**5.55**	**12.73**	**46.92**	**597.29**	**24.89(45%)**	**316.84**	2
3	0.10	7.18	4.94	12.12	41.09	498.01	-	498.01	

DPAM with DPCAM Comparison

This part compares DPAM with DPCAM resource costs with the winner about each sale which are displayed in Table 3. From Table 3, we declared the resources 2, 3, 1 and 3 are winners of DPAM. But we declared resources 1, 2, 3 then 2 are the winners of DPCAM. In DPAM through dynamic pricing mechanism we announce resource 2

as the winner that brings extreme resource usage. Although in DPCAM through dynamic pricing with a combinatorial auction scheme we announce resource 1 as a new winner. Utilization of resource displays the allotment of all resource tasks. Then, DPCAM's resource utilization are bigger than DPAM's resource utilization. The purpose is that the suppliers who never get the chance to win an auction in DPAM can win the sale in DPCAM. It means new supplier's triumph the sale by selling their resources.

Table 3. Comparison between DPAM and DPCAM

RID	PDPAM	PDPCAM	WDPAM	WDPCAM
a) Initial Auction				
1	54.96	**16.15**		
2	**28.55**	28.55	2	1
3	38.01	33.69		
b) First Auction				
1	130.70	37.44		
2	95.25	**20.75**	3	2
3	**72.90**	72.90		
c) Second Auction				
1	**132.53**	132.53		
2	277.48	226.71	1	3
3	165.06	**72.60**		
d) Third Auction				
1	601.53	330.99		
2	597.29	**316.04**	3	2
3	**498.01**	498.01		

Experimental Configuration:

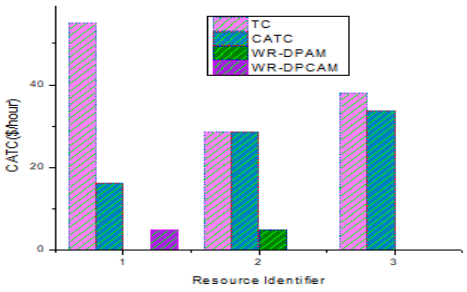
The simulation model executes on a system including the successive configurations: 2 cores of CPU, 8GB RAM, with Windows 7 Operating Systems. The streams are categorized into triple conditions: Demand-Driven Resource Provisioning, Event-Driven Resource Provisioning, and Popularity-Driven Resource Provisioning.

The resource capability is fixing from 500 to 5000 including numerical order. The cost of resource can be fixed from actual Microsoft Azure price list (https://azure.microsoft.com/) Cloud Users will receive a discount on Azure services by purchasing reservations.

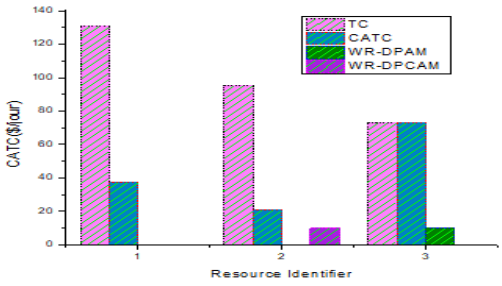
The tasks and resources are taken as inputs, those values are assigned to tempTask and tempResource variables, after that compute Combinatorial Auction time*cost (CATC) value and assign resource with low CATC value as the auction winner. Subsequently compute Reduction Rate for Bundle of Resources (RRBR). If we

consider bundle of resource, then the price reduction rate will be decreased. Our emergent cloud stream simulation, we had taken100 tasks and total resource availability is 70. DPAM gets 10% as price decrement ratio. In another scenario we had taken 500 tasks and the total resource availability as 350. Our method achieves about 15% of price decrement ratio. In next scenario we had taken 1000 tasks and the total resource availability as 700, our proposed system gives 30% of price decrement ratio. Hence the price decrement ratio will be increased according to bundle or resource requests. Similarly, we tested our algorithm for more test cases and it was efficient for all scenarios.

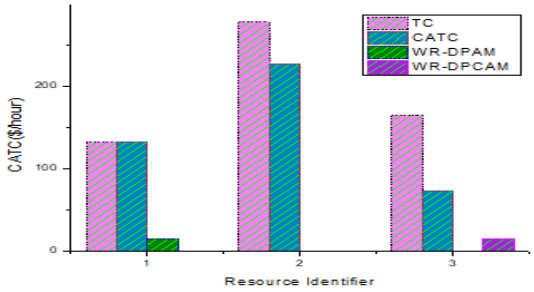
Resource charges and champion of every sale are analysed among DPAM with DPCAM as displayed in Figure 7 In initial auction, resource 2 as a winner in DPAM and resource 1 as a winner in DPCAM. Then in first iterative auction resource 3 is selected as a winner in DPAM and resource 2 is selected as a winner in DPCAM. In second iterative auction resource 1 is chosen as champion at DPAM and resource 3 a winner in DPCAM. Finally selected resource 3 is a winner in DPAM and resource 2 as winner in DPCAM. Using our dynamic pricing with combinatorial auction scheme we create an environment for all the resources to get a chance to win an auction.



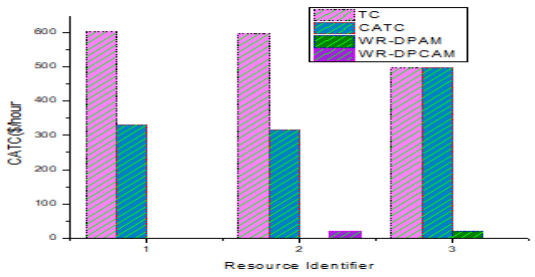
a) Initial Auction



b) First Iterative Auction



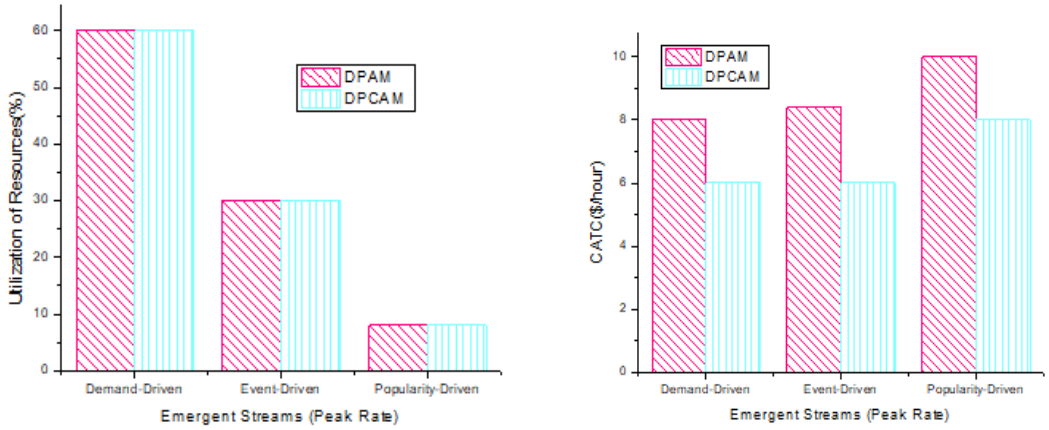
c) Second Iterative Auction



d) Final Auction

Figure 7. Winner Comparisons between DPAM and DPCAM

In this experiment, emergent streams are used to prove if DPCAM executes greater compared to DPAM on Utilization of resources with CATC. As displayed in Figure 8, utilization of resources in DPCAM is constantly greater compared to DPAM. This is due to the suppliers among less competing shift individual resource charges to buy bundle of resources and then that resources attain extra possibilities retailed. Peak time is the parameter used to monitor emergent streams. Figure 8 depicted, triple various conditions about CATCs of DPCAM are each lesser compared to DPAM. The previously mentioned method requires smaller period with lesser capital cost to get stream execution.



a) Utilization of Resources b) CATC

Figure 8. Utilization of resources and CATC of DPAM Vs DPCAM emergent streams

6. CONCLUSION

In this work, the proposed dynamic pricing strategy and dynamic user requests to enhance resource supplier's competing in cloud environment and increase the resource utilization rate. The novel combinatorial auction based dynamic pricing allotment mechanism was proposed to assign resources to get cloud streams. Using proposed technique, resource suppliers may shift the cost to improve the opportunity about auctioning resources with increasing extra income leading to enhance the usage of resources. The clients choose the most excellent resource including minimal combinatorial auction CATC (Product of Time and Cost), that guarantees smaller termination time with lower capital cost. Conclusively, the estimated proposed method is evaluated including the typical DPAM procedure.

7. ORGANIZATION OF THE THESIS

The thesis is organized as follows: Chapter 1 briefs the introduction about Cloud computing. In chapter 2, a comprehensive literature survey of modelling and optimization of the dynamic resource allocation in cloud computing is presented. IN Chapter 3 an Inclination based Progressive Resource Allotment Strategy in Cloud Computing Systems. The systems with both constant and variable job sizes with both homogenous and heterogeneous types of VMs have been studied.

Chapter 4 proposes an optimization platform for VM placement that minimizes the total power consumption of DC. The proposed Effectual Resource Allocation using Auction Mechanism in Cloud Computing. In Chapter 5 an optimal resource scheduling and dynamic pricing auction mechanism for supporting emergency demands in cloud computing is discussed. Chapter 6 concludes the research work and discusses the efforts made in this study as well as the best algorithm for DPCAM and MA mechanism. The research work concludes with the revelation of considerable recommendation for future investigation.

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List of Publications

1. R. Anantha Kumar and K. Kartheeban "Resource Allocation Using Dynamic Pricing Auction Mechanism for supporting Emergency Demands in Cloud Computing" *Journal of Parallel and Distributed Computing*, **158** (2021), 213-226
2. R. Anantha Kumar and K. Kartheeban "CLOUD SERVICE OPTIMIZATION BASED ON REVERSE AUCTION METHOD" *Journal of Theoretical and Applied Information Technology (JATIT)*, **100** (21) (2022), 6429- 6438.
3. R. Anantha Kumar and K. Kartheeban "Broker Based Collaborative Auction method for Resource Scheduling in Multi cloud" "*Operationalizing Multi-Cloud Environments: Technologies, Tools and Use Cases", EAI/Springer Innovations in Communication and Computing Series*, (2021), 325-335.
4. R. Anantha Kumar and K. Kartheeban "Study of Various Scheduling Procedures in Cloud Computing and Their Challenges" *Springer Nature Switzerland AG 2019 J. Hemanth et al*. (Eds.): ICICI 2018, LNDECT 26 (2018), 1529–1538.
5. R. Anantha Kumar and K. Kartheeban "An Inclination based Progressive Resource Allotment Strategy in Cloud Computing Systems" *International Conference on Clean Energy and Energy Efficient Electronics Circuit for Sustainable Development, IEEE International Conference on INCCES*, (2019), 9167743.